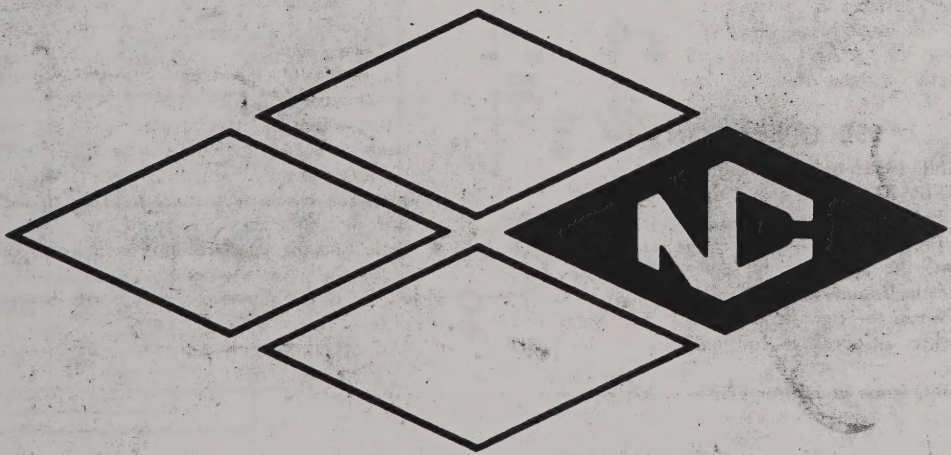
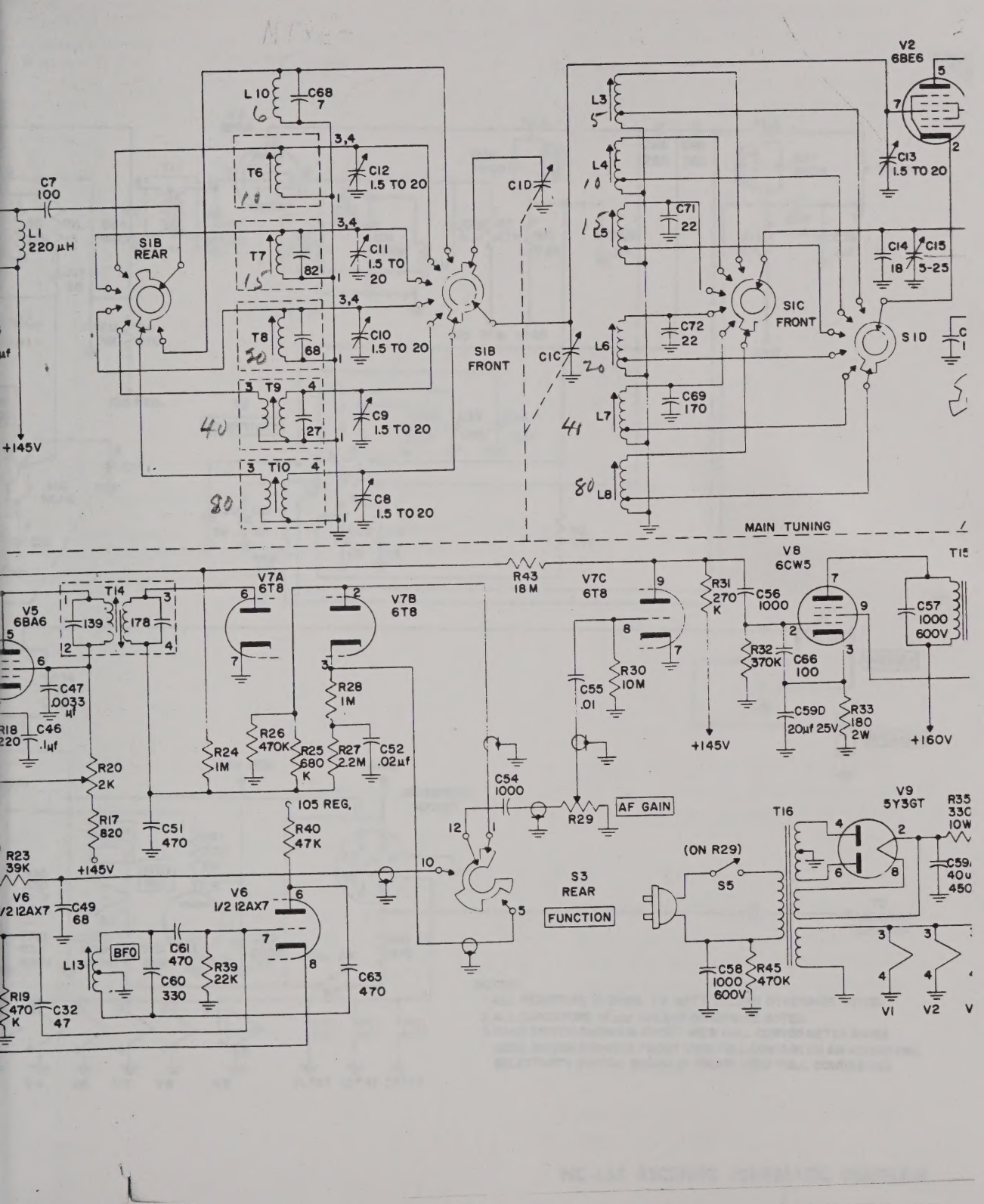
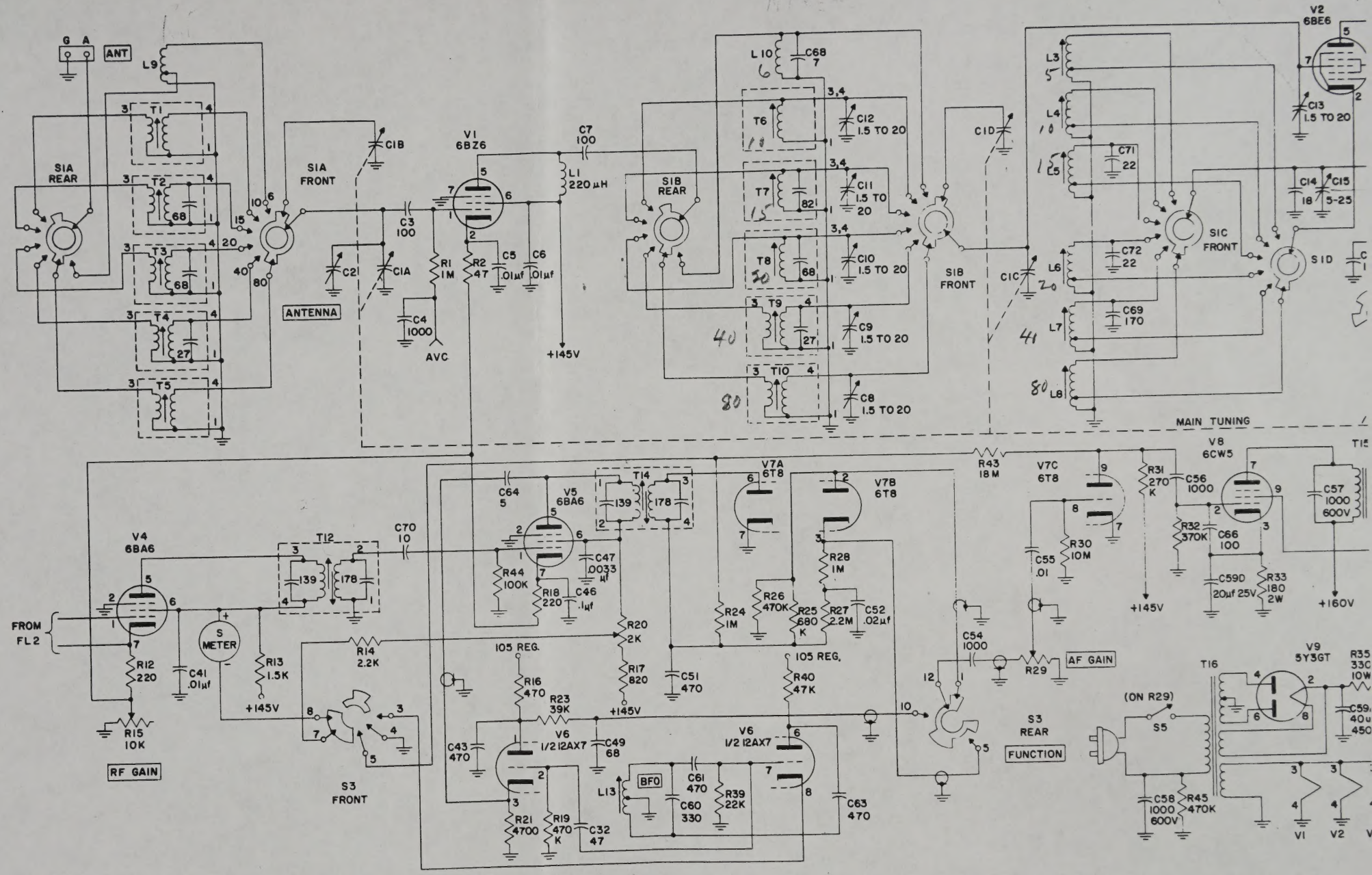
NC-155 RECEIVER

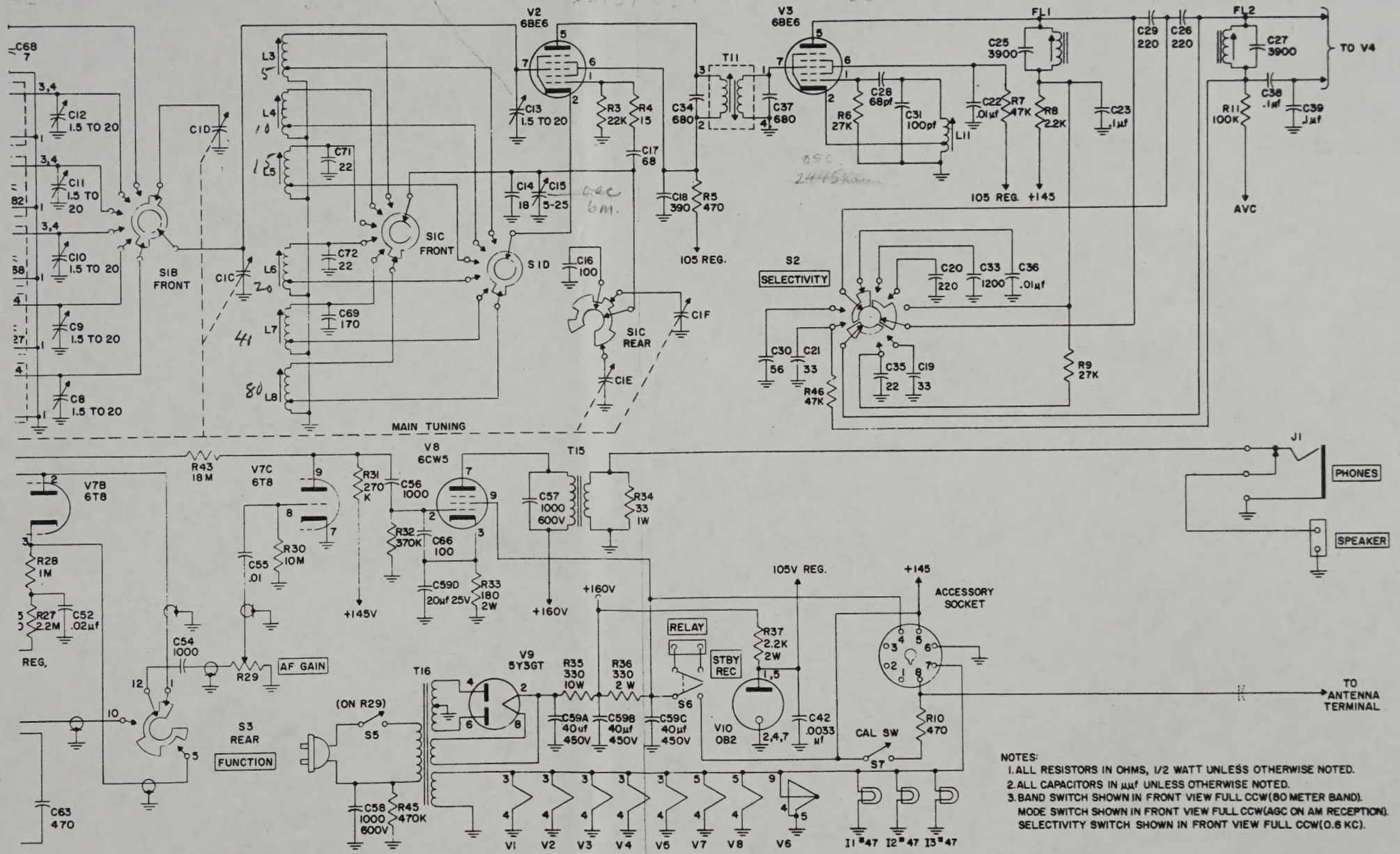
Instruction Manual



NATIONAL RADIO COMPANY


L10
C68
7
T6
C12
1.5 TO 20
T7
82
C11
1.5 TO
20
T8
68
C10
1.5 TO 20
T9
27
C9
1.5 TO 20
T10
C8
1.5 TO 20
C7
100
L1
220 µH
+145V
S1B
REAR
S1B
FRONT
C1D
C1C
L3
L4
L5
C71
22
L6
C72
22
L7
C69
170
L8
S1C
FRONT
S1D
V2
6BE6
C13
1.5 TO 20
C14
18
C15
3-25
MAIN TUNING
V5
6BA6
T14
139
178
C47
.0033
µf
C46
.1µf
R18
220
R20
2K
R17
820
C51
470
V7A
6T8
V7B
6T8
R24
1M
R26
470K
R25
680
K
R27
2.2M
C52
.02µf
R28
1M
105 REG.
R40
47K
R43
18 M
V7C
6T8
R30
10M
C55
.01
R31
270
K
C56
1000
R32
370K
C66
100
C59D
20µf 25V
R33
180
2W
+145V
V8
6CW5
C57
1000
600V
+160V
C54
1000
R29
AF GAIN
S3
REAR
FUNCTION
(ON R29)
S5
T16
V9
5Y3GT
R35
330
10W
C58
1000
600V
R45
470K
V1
V2
R23
39K
+145V
V6
1/2 12AX7
C49
68
V6
1/2 12AX7
BFO
L13
C61
470
C60
330
R39
22K
C63
470
R19
470
K
C32
47


G A
ANT
L9
T1
T2
T3
T4
T5
SIA REAR
SIA FRONT
C1B
C2
C1A
ANTENNA
C3 100
C4 1000
AVC
V1 6BZ6
R1 1M
R2 47
C5 .01μf
C6 .01μf
C7 100
L1 220 μH
+145V
L10
C68 7
T6
T7
T8
T9
T10
C12 1.5 TO 20
C11 1.5 TO 20
C10 1.5 TO 20
C9 1.5 TO 20
C8 1.5 TO 20
S1B REAR
S1B FRONT
C1D
C1C
L3
L4
L5
L6
L7
L8
C71 22
C72 22
C69 170
S1C FRONT
S1D
V2 6BE6
C13 1.5 TO 20
C14
C15 5-25
MAIN TUNING
V4 6BA6
T12
C70 10
V5 6BA6
T14
C64 5
C47 .0033 μf
R44 100K
R18 220
C46 .1μf
V7A 6T8
V7B 6T8
R24 1M
R26 470K
R25 680 K
R27 2.2M
C52 .02μf
R28 1M
R43 18M
V7C 6T8
R31 270 K
C56 1000
R32 370K
C66 100
C59D 20μf 25V
R33 180 2W
V8 6CW5
C57 1000 600V
+160V
+145V
C55 .01
R30 10M
FROM FL2
S METER
R12 220
R15 10K
RF GAIN
C41 .01μf
R13 1.5K
+145V
R14 2.2K
S3 FRONT
105 REG.
R16 470
R23 39K
R17 820
R20 2K
C51 470
C54 1000
R29
AF GAIN
S3 REAR
FUNCTION
V6 1/2 12AX7
C43 470
C49 68
R21 4700
R19 470 K
C32 47
BFO
L13
C61 470
C60 330
R39 22K
C63 470
R40 47K
(ON R29)
S5
T16
V9 5Y3GT
R35 330 10W
C59A 40μ 450
C58 1000 600V
R45 470K
V1
V2



NOTES:
1. ALL RESISTORS IN OHMS, 1/2 WATT UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS IN µµf UNLESS OTHERWISE NOTED.
3. BAND SWITCH SHOWN IN FRONT VIEW FULL CCW(80 METER BAND). MODE SWITCH SHOWN IN FRONT VIEW FULL CCW(AGC ON AM RECEPTION). SELECTIVITY SWITCH SHOWN IN FRONT VIEW FULL CCW(0.6 KC).

NC-155 RECEIVER SCHEMATIC DIAGRAM

ALIGNMENT INSTRUCTIONS

The NC-155 receiver has been carefully aligned at the factory by specially trained and experienced personnel using precision equipment. Alignment of the receiver should not be attempted until all other possible causes of faulty operation have been investigated. Alignment should be made only by persons familiar with communications receivers and experienced in their alignment. Refer to illustration for location of all alignment adjustments.

EQUIPMENT REQUIRED:

1. Signal generator covering 450 kc to 55 mc.
2. Vacuum tube voltmeter (VTVM)
3. Output meter. The AC scale of the VTVM can be used.
4. Tuning Wand — General Cement No. 8278 or equivalent.
5. K Tran Tool — General Cement No. 5097 or equivalent.

INITIAL CONTROL SETTINGS:

Bandswitch.....As indicated in chart.
RF and AF Gain.....Fully Clockwise.
Mode Switch.....AM with AGC off.
Selectivity.....As indicated in chart.
Tuning.....Plates half-meshed unless otherwise indicated.
Antenna Trimmer.....Mid range.
Lateral Dial Adjustment.....Mid range.
Calibrator.....Off.

ALIGNMENT PROCEDURE:

230 KC IF ALIGNMENT

Signal Generator Connections	Signal Generator Frequency	Bandswitch Setting	Output Connections	Selectivity Setting	Remarks
High side directly to pin 7 of 2nd 6BE6. Low side to chassis.	230 kc (unmodulated)	80 M	VTVM DC Probe to junction of R24, R25, and C51. Low side to chassis.	0.6 kc	Adjust FL1, FL2 for maximum indication. Rock generator to insure both cores tune through maximum. Peak both sides of T12 and T14. Maintain approximately 2V reading on VTVM.

2215 KC IF ALIGNMENT

Signal Generator Connections	Signal Generator Frequency	Bandswitch Setting	Output Connections	Selectivity Setting	Remarks
High side directly to mixer section of tuning gang.	2215 kc (unmodulated)	80 M	VTVM DC probe to junction of R24, R25, and C51. Low side to chassis.	0.6 kc	Tune L11 to approximately 2445 kc for maximum response. Check to insure image is at 2675 kc. Peak top and bottom of T11. Maintain approximately 2V reading on VTVM.

order to add tone to the calibrator signal and make identification of the signal less difficult. After an appropriate calibrator signal has been tuned, the operator may observe that this signal does not correspond exactly to the 1 mc calibration point of the dial scale. In this event, the CALIBRATE switch knob may be moved from side to side thus moving the entire dial scale to place the calibrated mark directly over the tuning pointer. Once this is achieved, the calibrator may be turned off and an accurate calibration is assured.

The power supply of the NC-155 receiver is a conventional transformer-type power supply which employs a 5Y3GT tube in a full-wave rectifier circuit with a suitable power supply filter and a shunt feed to an OB2 voltage regulator tube. The OB2 is used to regulate the plate supply voltage to the high frequency or first converter oscillator and the beat frequency oscillator. A STBY-REC (standby-receive) switch is provided in the 145 volt supply bus in order to remove power from the plate and screens of most tubes for STBY operation. Terminals 4 and 5 of the accessory socket are wired in parallel with the STBY-REC switch for remote control of the receiver.

STBY-REC

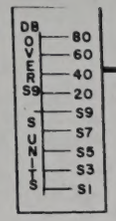
The STBY-REC switch is a two-position toggle switch which may be set at STBY to mute the receiver, or placed in the REC position for normal operation. An auxiliary pair of terminals on this switch is connected to the rear relay terminals in such a manner that the rear relay terminals are effectively open-circuited in the REC position and short-circuited in the STBY position. This allows control of an external relay circuit by means of the STBY-REC switch. If the STBY-REC switch is placed in the STBY position the receiver may be activated by externally shorting terminals 4 and 5 of the receiver.

The mechanical structure of the NC-155 employs a solid 1/8" panel for extreme mechanical rigidity and stability. A separate bottom cover and cabinet top are employed for ease in servicing and the National Radio Company patented Flip-Foot has been added for operator convenience.

CABINET

The Flip-Foot of the NC-155 receiver may be easily elevated into the raised position, or dropped back to the flat position for maximum operating ease. To elevate the Flip-Foot, simply lift the forward portion of the cabinet and reach under and pull the rear edge of the Flip-Foot down and forward until it reaches its forward or upright position. To remove the top half of the cabinet for normal service, it is necessary only to remove the two screws on the lower forward corner of each side of the cabinet and the two screws at the lower outside corners of the back. It is then possible to remove the cabinet top by simply lifting and springing the front top lip of the cabinet free from the retaining clips attached to the panel. The cabinet is simply replaced by reversing this procedure, taking care to engage the slots in the forward lip of the cabinet into the two clips welded to the rear of the top section of the panel. The bottom cover of the receiver may be removed independently by removing the two rear mounting feet which serve as combination mounting feet and retaining screws, and by removing the four retaining screws. After removing these screws, the bottom cover may be slipped to the rear and removed from under the Flip-Foot to allow free access to the wiring of the receiver.

AM SIGNAL STRENGTH METER AND TUNING INDICATOR. WHEN RFG IS ADVANCED FOR AN S-1 READING ON BACKGROUND NOISE AN "S-9" READING IS APPROXIMATELY EQUIVALENT TO A 50 MICROVOLT INPUT AT THE ANTENNA TERMINALS. THE S METER DOES NOT OPERATE WHEN THE MODE SWITCH IS IN ANY OF THE "AGC" POSITIONS.



CALIBRATE

MOVES DIAL SCALES HORIZONTALLY TO LINE UP DIAL POINTER READINGS WITH ONE MC CALIBRATOR MARKERS, AND TURNS ON ACCESSORY CRYSTAL CALIBRATOR WHICH PROVIDES ACCURATE CW MARKERS EVERY ONE MC. THESE MARKERS PERMIT ACCURATE DIAL CALIBRATION.

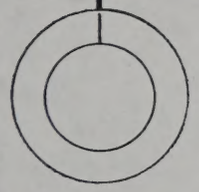
B.F.O.

ADJUSTS THE TUNING OF THE BEAT FREQUENCY OSCILLATOR TO SET THE PITCH OF CW SIGNALS. SET BFO CONTROL TO THE USB OR LSB MARK TO PUT THE BFO FREQUENCY ON THE SLOPE OF THE IF PASSBAND FOR SSB RECEPTION.

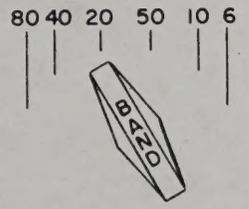
R.F. GAIN

ADJUSTS THE RECEIVER RF AND IF GAIN. USUALLY USED AS A VOLUME CONTROL IN "AGC OFF" POSITIONS OF THE MODE SWITCH. THIS CONTROL ALSO REDUCES THE RECEIVER GAIN AND THE S METER SENSITIVITY IN THE "AGC ON" POSITIONS OF THE MODE SWITCH.

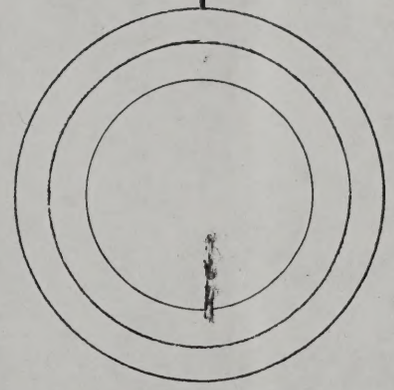
ANTENNA



ADJUSTS RECEIVER INPUT CIRCUIT FOR BEST ANTENNA MATCH ON EACH BAND AS INDICATED BY MAXIMUM SIGNAL STRENGTH. THIS CONTROL SHOULD BE ADJUSTED EACH TIME A DIFFERENT BAND IS SELECTED.

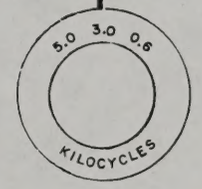


SELECTS DESIRED AMATEUR BAND. THE DIAL SCALE WHICH CORRESPONDS TO THE SELECTED BAND IS USED TO INDICATE THE FREQUENCY OF RECEIVER TUNING.



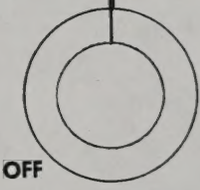
THIS CONTROL SELECTS THE DESIRED RECEPTION FREQUENCY AS INDICATED ON THE SLIDE RULE DIAL.

SELECTIVITY



SELECTS THE DESIRED RECEIVER BANDWIDTH FOR THE EXISTING SIGNAL CONDITIONS. THE 0.6 KC POSITION IS RECOMMENDED FOR CW RECEPTION. THE 5 KC POSITION IS RECOMMENDED FOR FULL FIDELITY AM RECEPTION. THE 3 KC POSITION MAY BE USED FOR SINGLE SIDEBAND RECEPTION OR AM RECEPTION UNDER CROWDED BAND CONDITIONS.

A.F.G.



CONTROLS THE RECEIVER OUTPUT LEVEL BY SETTING THE GAIN OF THE AUDIO AMPLIFIER. THE SWITCH TURNS THE ENTIRE RECEIVER ON AND OFF.

STBY REC.

SILENCES RECEIVER DURING TRANSMISSION PERIODS. INSTANTLY RETURNS RECEIVER TO FULL OPERATION WITH NO WARM-UP REQUIRED. ALSO SHORTS RELAY CONTACTS ON REAR APRON.

EARPHONE JACK SILENCES SPEAKER WHEN EARPHONE PLUG IS INSERTED.

FUNCTION

SELECTS THE DESIRED RECEPTION MODE, WHICH MAY BE EITHER STRAIGHT AM OR AM WITH AUTOMATIC NOISE LIMITER OR CW-SINGLE SIDEBAND RECEPTION. LEFT HAND POSITIONS CORRESPOND TO AGC OFF AND RIGHT HAND POSITIONS CORRESPOND TO AGC ON.

NC-155 CONTROL FUNCTIONS

It is not normally necessary to detune the beat oscillator from this setting. When receiving CW signals, a mid-position setting of the beat oscillator would correspond to a condition wherein the maximum IF selectivity occurs at zero beat with the incoming signal and no audio tone would be observed at the point of maximum signal reception. It is therefore necessary to slightly detune the beat oscillator in either direction to provide a suitable audio tone which is comfortable to the operator and to obtain maximum sensitivity. During CW reception it is often convenient to adjust the beat oscillator to phase an undesired signal to zero beat, thus eliminating it as an audible interfering signal.

The signal from the beat oscillator is coupled through a small capacitor to the grid of the other 12AX7 triode which serves as a triode product detector. The IF signal from the plate of the second IF tube is coupled through a small capacitor to the cathode of the product detector and the desired product appears in the plate circuit. The undesired mixer products are filtered out, and the audio signal is coupled to the FUNCTION switch through an RF filter composed of resistor R23 and capacitor C49.

FUNCTION SWITCH

The FUNCTION switch allows selection of the AM signal or the output of the automatic noise limiter (ANL) with AGC either operating or not operating, and also allows selection of the output from the product detector for single sideband (SSB) or CW reception. In normal operation, the noise limiter may be used at will, depending on incoming noise level and operating convenience. In the event that CW or single sideband reception is desired, it is essential that the mode switch be placed in the CW-SSB position. The ANL, AM and CW-SSB positions appear twice on the mode switch corresponding to operation with AGC either on or off for each receiving mode.

The S meter is connected between the plates of the two 6BA6 IF stages and, as was mentioned above, the AGC is applied to the first of these IF stages with the result that as signal amplitude increases, conduction through the first IF stage is decreased, but conduction through the last IF stage remains constant, thereby changing the potential difference between the plates which causes a current flow and an effective meter reading. The zero-adjust is accomplished by adjusting the S Meter Zero Adjust control to establish zero potential difference across the meter under conditions of no incoming signal.

S METER

Normal adjustment of the S Meter is readily accomplished by increasing the RF GAIN control to maximum sensitivity which corresponds to its extreme clockwise setting. The receiver should be tuned so that only background noise is heard and the antenna trimmer peaked. The S Meter Zero Adjust control should then be adjusted for a reading of approximately S1 on the incoming noise level which will assure proper S Meter reading. When properly adjusted, an S Meter reading of S9 will correspond to approximately 50 microvolts of signal at the antenna terminals.

The desired audio signal output from the FUNCTION switch is then coupled to the AUDIO GAIN control and in turn, to the grid of the first audio amplifier which is the triode section of the 6T8 tube.

AUDIO GAIN

The AUDIO GAIN control is used to adjust the speaker or earphone level to comfortable listening volume. It is important not to confuse the function of the AUDIO GAIN control with the function of the RF GAIN control which controls the over-all receiver sensitivity. Normally, with the RF GAIN control advanced to provide proper S Meter reading, all additional variation of listening level is accomplished with the AUDIO GAIN control. In the event of operation with AGC off, the RF GAIN control is sometimes used as the master sensitivity control and the AUDIO GAIN control is left set in a predetermined position. Proper balance between the two controls under this condition is normally a matter of individual operating preference.

The output from the plate of the first audio amplifier is impedance-coupled directly to the grid of the 6CW5 audio output stage. The amplified audio is taken from the plate of the audio output stage through the audio transformer to the speaker terminals. The secondary winding of the audio transformer is designed to match a 3.2-ohm speaker such as the matching NTS-3 table speaker assembly. The secondary of the audio transformer is also connected through a shorting type phone jack which is so wired that upon the insertion of a standard phone plug the loud speaker circuit will be broken and the speaker silenced.

PHONE JACK

The head phone jack is available on the front panel and will accept any normal 2 circuit phone plug. There is no DC voltage associated with the head phone circuit. Because of the low impedance of the audio transformer secondary, almost any type of head phone may be used with completely satisfactory results.

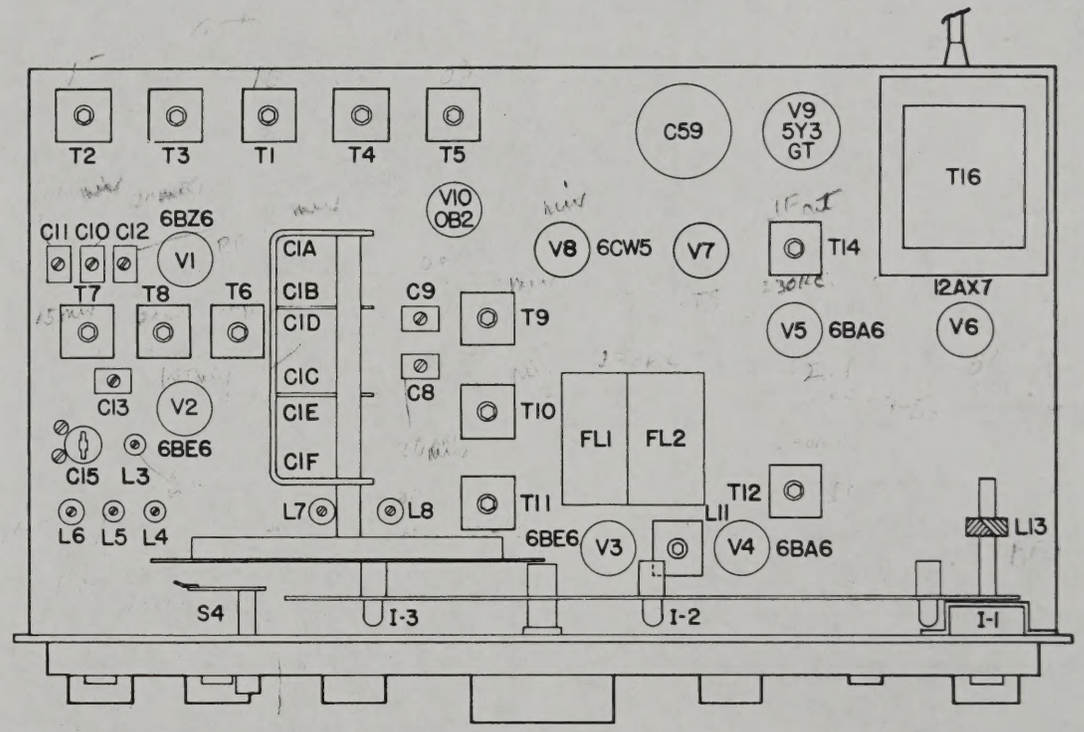
An accessory socket is provided on the rear apron of the NC-155 receiver and is wired to accept the XCU-109 one megacycle crystal calibrator. Power to this accessory socket is provided through the front panel CALIBRATE switch. The signal from this accessory calibrator is coupled to the antenna terminals of the receiver to provide a strong CW signal at every 1 mc point on the dial.

CALIBRATE SWITCH

To properly calibrate the dial, with the accessory XCU-109 calibrator, the RF GAIN control should be advanced to normal receiver sensitivity and the front panel CALIBRATE switch should be rotated to the ON position. The calibrator signal may then be tuned at any even 1 mc point on the dial scale corresponding to the band in use. It is sometimes convenient to use the CW mode reception in

BFO ALIGNMENT

Signal Generator Connections	Signal Generator Frequency	Bandswitch Setting	Output Connections	Selectivity Setting	Remarks
High side directly to pin 7 of 2nd 6BE6. Low side to chassis.	230 kc (unmodulated)	80 M	VTVM DC probe to junction of R24, R25, and C51. Low side to chassis.	0.6 kc	Rock generator for maximum output. Maintain approximately 2V reading on VTVM. Set mode switch to CW-SSB. Set BFO knob to center mark on panel. Loosen set screw and adjust L13 to zero beat with screwdriver through hole in shield. Then tighten set screw and return mode switch to AM-AGC OFF position.



TOP VIEW

RF ALIGNMENT

Before proceeding with RF alignment, check dial pointer for proper indexing. With tuning gang fully closed, set the pointer so that it is directly under "set" mark at low end of 80 M band with the lateral dial control set in mid-position.

Attach temporary bottom plate to receiver.

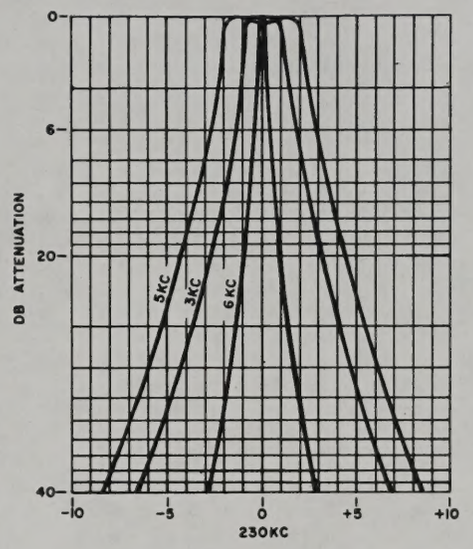
OUTPUT METER CONNECTIONS — VTVM DC probe to junction of R24, R25, and C51. Low side to chassis. Maintain approximately 2 V reading on VTVM.

SIGNAL GENERATOR CONNECTIONS — Connect high side of generator to "Ant." terminal through a 68 ohm 1/2W resistor. Low side to "G" terminal.

CONTROL SETTINGS — Adjust generator for 30 per cent modulation. Set selectivity control for 3.0 kc, and all other controls at their initial settings given previously.

GENERAL INSTRUCTIONS — Always check for proper tracking on each band by inserting tuning wand into mixer and antenna transformers. Repeat high and low end steps until tuning wand shows reduced output, with either end inserted into both mixer and antenna coils. If pointer does not read close to the correct frequency at the low end of all bands (except 6 M), C15 must be re-adjusted. If pointer reads above the correct frequency, reduce C15 capacity. If pointer is below, reduce C15 capacity. Then repeat the entire RF alignment procedure, omitting all C15 adjustments. Oscillator frequency is always on the high side of signal frequency, except on 6 M band. Suitable precautions or checks should be used to insure these conditions.

	Bandswitch Setting	Generator and Receiver Frequency	Adjust for Maximum	
Step #1	6 M	50.0 mc	L3 L10 L9	(oscillator slug) (mixer coil) spread turns (antenna coil) spread turns with antenna trimmer ¼ closed.
Step #2	6 M	54.0 mc	C15 C13 C2	(oscillator trimmer) (mixer trimmer) (antenna trimmer)
Step #3	10 M	29.7 mc	L4 C12 C2	(oscillator slug) (mixer trimmer) (antenna trimmer)
Step #4	10 M	28.0 mc	T6 T1	(mixer slug) (antenna slug)
Step #5	15 M	21.5 mc	L5 C11 C2	(oscillator slug) (mixer trimmer) (antenna trimmer)
Step #6	15 M	21.0 mc	T1 T2	(mixer slug) (antenna slug)
Step #7	20 M	14.35 mc	L6 C10 C2	(oscillator slug) (mixer trimmer) (antenna trimmer)
Step #8	20 M	14.0 mc	T8 T3	(mixer slug) (antenna slug)
Step #9	40 M	7.3 mc	L7 C9 C2	(oscillator slug) (mixer trimmer) (antenna trimmer)
Step #10	40 M	7.0 mc	T9 T4	(mixer slug) (antenna slug)
Step #11	80 M	4.0 mc	L8 C8 C2	(oscillator slug) (mixer trimmer) (antenna trimmer)
Step #12	80 M	3.5 mc	T10 T5	(mixer slug) (antenna slug)



SELECTIVITY CURVES

The signal appearing across the secondary winding of the Ferrite Filter is applied to the grid of the first 6BA6 IF stage which operates as a conventional signal amplifier at 230 kc. The 230 kc signal from the plate of the first IF stage is coupled to the grid of the second 6BA6 IF stage through a conventional double-tuned transformer.

The cathode of both 6BA6 stages and the 6BZ6 RF stage are returned to the chassis by way of the RF gain bus and the RF gain control. As the resistance of the RF gain control is increased, additional cathode bias is built up across it, thus reducing the over-all receiver gain. Small resistors are used in the individual cathode leads in order to keep the RF and IF tubes in rating when the RF gain control is set at maximum.

RF GAIN

The sensitivity of the receiver is adjusted by means of the RF GAIN control which controls the cathode bias on the RF and both 6BA6 IF stages. When the control is rotated to its maximum counterclockwise position, the sensitivity of the receiver will be reduced to the point where no signal can be received. Rotating the control clockwise will increase sensitivity until maximum is reached at the full clockwise position. During CW or single sideband reception, the RF GAIN knob may be used freely as a means of sensitivity adjustment as the receiver is tuned from signal to signal. For AM reception, the RF GAIN control should be set to a comfortable sensitivity level and allowed to remain in this position. Adjustment of the RF GAIN control will have some effect on the S Meter reading. For proper indication of the S Meter it is recommended that the receiver be detuned from any signal and the RF GAIN control advanced until the background noise reaches a level sufficient to cause a reading of approximately 1 unit on the S Meter. This setting of the RF GAIN control should then suffice for all normal AM signal conditions.

The signal appearing at the plate of the last 6BA6 IF stage is coupled to the AM detector by means of a conventional, inductively-coupled, double-tuned IF transformer operating at the second IF frequency at 230 kc. The diode at pin 6 of the 6T8 tube is used as a conventional AM detector. Resistors R25 and R26 comprise the detector load.

The AGC signal is derived from the high end of the detector load with resistors R24, R11, and capacitor C38 functioning as an AGC filter to remove the audio signal appearing across the detector load. This AGC signal is applied directly to the grid of the first 6BA6 IF tube through the secondary winding of the Ferrite Filter. The AGC signal is also applied through R1 to the grid of the 6BZ6 rf stage.

The audio signal appearing across R26, a portion of the detector load, is coupled directly to the mode switch or to the plate of the separate diode portion of the 6T8 detector-audio tube. The cathode of this diode is supplied with a filtered dc signal also derived from the detector load. The dc signal is equal in level to the peak audio amplitude, thereby keeping the diode conducting for all normal modulation. Should a noise pulse occur, the high negative noise spike across the audio portion of the detector load takes the plate of the noise-limiter negative with respect to its cathode, and conduction ceases, thereby effectively removing the noise peak from further signal circuits. This noise peak does not appear at the cathode of the noise limiter due to the filtering action of resistor R27 and capacitor C52. The audio output occurring on the cathode of the noise limiter circuit is also coupled to the FUNCTION switch. In the event of CW or single sideband reception, the FUNCTION switch grounds the cathode of one-half of the 12AX7 which serves as a beat frequency oscillator using a grounded-cathode Hartley oscillator circuit.

BFO

The BFO control is used to adjust the frequency of the beat-frequency oscillator which correspondingly varies the pitch of the generated audio tone. When receiving single sideband signals, the BFO should be set to the USB or LSB mark depending on the sideband desired (generally LSB on 80- and 40-meters and and USB on 20-, 15-, and 10-meters). This setting will properly position the BFO relative to the IF passband for SSB reception.

the amateur band is use. The adjustment is necessary because the use of various types of antennas will have some detuning effect on the antenna stage. The use of the antenna trimmer compensates the receiver to match the type of antenna which may be connected to it. It is normally necessary to set the ANTENNA control only once for each band in use. This is best accomplished by tuning the receiver away from any signal and adjusting the ANTENNA control for maximum background noise in the speaker or earphones. Normally, it should not be necessary to repeak the antenna trimmer for different settings on the same amateur band. However, if the BAND switch is used to change the band in use, the antenna trimmer must be repeaked for the newly selected frequency.

The signal appearing across the tuned circuit of the antenna stage is coupled through a capacitor to the grid of a 6BZ6 tube which operates as the RF stage of the NC-155 receiver. Automatic gain control (AGC) voltage is also applied to this grid to adjust the gain (of the RF stage) to a level suitable for the strength of the signal being received.

Supply potentials for the plate circuit of the RF stage are supplied through the choke L1; and the RF signal is coupled to the primary of the mixer coil through capacitor C7. As in the case of the antenna stage, this primary winding of the mixer coil is an untuned circuit. On the 20-, 15-, 10-, and 6-meter bands, no primary winding is used, and the signal from the plate of the RF stage is coupled directly to the tuned interstage coil. The BAND switch, once again, performs the function of selecting the right coil for the band in use. The secondary of the mixer coil is tuned to further add to the RF selectivity of the receiver. This tuning is accomplished by means of the main tuning capacitor, alignment trimmers C8 through C13 and, in some instances, with an additional fixed capacitor used to obtain proper tracking over the frequency band. Again, as in the antenna tuned circuit, the main tuning capacitor is split into two sections with one or both sections being used, depending on the band selected. The signal appearing across the mixer tuned circuit is coupled directly to the signal grid of the 6BE6 first converter tube.

A grounded-plate Hartley oscillator circuit is used for purposes of signal conversion to the first IF frequency. This oscillator is a part of the 6BE6 first converter tube. As before, the proper oscillator coil is selected by the band switch, and the oscillator tank circuit is tuned by the main tuning capacitor and the alignment trimmer C15. In order to obtain a high degree of stability in the oscillator, a special zero temperature coefficient ceramic capacitor C16 is used to form the predominant portion of the tuned circuit. In addition, a small negative temperature-compensating capacitor C14 is used to compensate for the positive temperature coefficient of the coils. This combination of parts results in temperature stability of the NC-155 receiver which will surprise even the most experienced operator. The oscillator frequency is always 2215 kc above the signal frequency to which the receiver is tuned, thus generating a 2215 kc first IF signal. This signal is fed from the plate of the 6BE6 first converter to a conventional double tuned IF transformer which serves as the interstage coupling between the first and second converters. Signal coupling is accomplished by means of the mutual inductance between the primary and secondary of this interstage transformer, and the resulting signal is applied to the signal grid of the 6BE6 second converter tube. The selectivity of this first IF circuit provides excellent secondary IF image rejection and at the same time is high enough in frequency to provide excellent primary image rejection which results from the tuned antenna and mixer circuits. The second converter oscillator is a grounded-plate Hartley circuit using the screen of the 6BE6 converter as the grounded plate. This second IF oscillator frequency is set at 2445 kc which beats with the 2215 kc signal to produce a 230 kc IF output.

The 230 kc IF signal is coupled from the plate of the 6BE6 second converter tube to the National Ferrite Filter. The Ferrite Filter circuit uses two tuned circuits with the "Q" of the individual coils running approximately 500. The two tuned circuits are impedance-coupled one to the other with the selectivity switch performing the function of changing the coupling impedance and damping to achieve variations of bandwidths from the narrow 600 cycle position to the wide 5 kc position. In addition to changing the degree of coupling and damping, small tuning capacitors are switched to center all pass bands thus eliminating the need for retuning when the selectivity is changed.

SELECTIVITY SWITCH

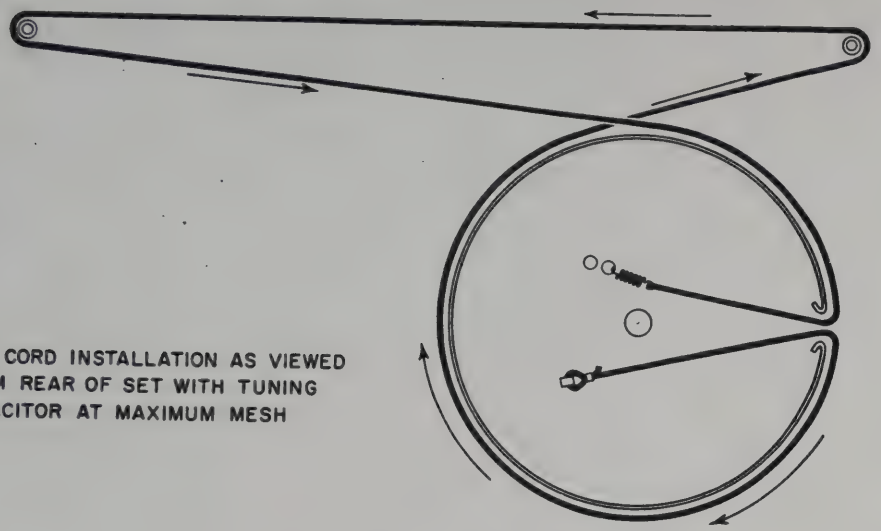
The SELECTIVITY switch of the NC-155 receiver provides for three degrees of selectivity. The SELECTIVITY switch is marked with positions for 5 kc, 3 kc, and 0.6 kc. The degree of selectivity used depends largely on the mode of operation desired, and signal conditions. The 5 kc position would normally correspond to the highest receiver fidelity. However, under conditions of extreme signal interference, it is often desirable to reduce the bandwidth of the receiver and sacrifice fidelity in favor of less interference by using the 3 kc position. When CW reception is desired, further bandwidth reduction is effective and useful, and it is recommended that the 600 cycle (0.6 kc) position be used. In normal AM operation, the 3 kc or 5 kc bandwidth positions provide an adequate degree of selectivity. For CW operation, as stated above, the 600 cycle bandwidth is recommended; and for single sideband operation, the 3 kc bandwidth is recommended.

PARTS LIST

ALL READILY AVAILABLE RESISTORS AND CAPACITORS ARE OMITTED FROM THE FOLLOWING PARTS LIST, BUT ARE COMPLETELY IDENTIFIED ON THE SCHEMATIC.

	PART NAME	PART NO.
I1, I3	Panel Lamp	NPL47
V1	6BZ6 Tube	6BZ6
V2, V3	6BE6 Tube	6BE6
V4, V5	6BA6 Tube	6BA6
V7	6T8 Tube	6T8
V6	12A7 Tube	12A7
V8	6CW5 Tube	6CW5
V10	OB2 Tube	OB2
V9	5Y3-GT Tube	5Y3-GT
R17	Resistor 330 ohm 10W ±10%	B17436-1
C69	Capacitor – Mica 170mmf ±1%	NCS-20-171-F-5
C25, C27	Capacitor – Mica 3900mmf ±1%	NCS-20-392-F-5
C16	Capacitor – Ceramic 100mmf ±2% Special ±10 PPM	A50113
L1	RF Choke Encapsulated	A50206-1
	Line Cord	B50473-1
	Front Panel – Complete	D50492-3
	Coil Mtg – Bushing	A50107
	Clamp, BFO Coil	A50148-52
	Slug Iron, BFO	B50188-4
L13	Coil BFO	B50470
	Spring Slug Screw	A50421
	Window – Complete	B50493-2
	Pointer Rail	B50110-3
	Window Light Shield	C50498-4
S7	Switch Calibrate	B50578
	S Meter	C50441-1
	Pointer	B50130
	Dial Cord Assy	B19347
	Bushing Panel	50598
	Bushing Nut	A50117-4
	Pinch and Vernier Assy	B50599
	Bowed Ring (Snap)	A50282-4
	Bezel Front Panel	B50132-1
	Knob – BFO	B50518-2
	Knob – RFG or Depth	B50519-2
	Set Screw No. 6 X 3/8	SS-6-R-C-6-X
	Set Screw No. 6 X 1/8	SS-6-R-C-2-Z
	Knobs – AFG and Ant.	D22500-X42-X-4AC
	Knob – Mode	D22500-X42-X-4U
	Knob – Selectivity	D22500-X42-X-4Z
	Knob – Band	C11916-6
	Knob Assy. Main Tuning	B13599-5
	Knob, Calibrate and Lateral	B50586-Z
	Sockets, Light	B50300
	Flip Foot, Silver	B50145-2
	Rivets	SR-125-B-14-N
	Push-on Tinnerman	A50284-1
	Rubber Foot	A50281-2

	PART NAME	PART NO.
	Bottom Cover Painted	D50462-2
	Cabinet Assy Complete	D50418-5
	Rails, Dial	B50496
	Panel Terminal (Relay)	A12616
	Panel Terminal (Speaker)	A12617
	Panel Terminal (Antenna)	E265-28
	Socket 7 pin Black Phenolic	B27669-3
	Socket 9 pin Black Phenolic	B27668-1
	Socket Octal	B27674-1
T15	Transformer – Output	B22025-2
C1	Main Tuning Capacitor	C50529-2
	Disc Drive	A50125
C15	Trimmer Ceramicon	B19783-2
T16	Transformer – Power	C50087
C59	Capacitor – Electrolytic	C19458-5
C8-C12	Capacitor – Mica Trimmer	A50137
R20	Potentiometer – S Meter	B50466
R29	Potentiometer – AF Gain	B50089
S2	Switch – Selectivity	B50431
S3	Switch – Mode	B50490
R15	Potentiometer – RF Gain	B50092
J1	Phone Jack	A50263
S6	Switch Toggle	B50205
	RF Shield	C50093
S1	Switch Band	C50094
C2	Variable Capacitor – Antenna	B50095
	Coupling Spring	B25000
T12, T14	Transformer – IF Output	B50103
L11	2nd Oscillator Coil	B50443
FL1, FL2	Ferrite Filter	B50529
T11	Transformer – 2215 kc	B50510
T5	Coil – Antenna 80 M	B50167
T4	Coil – Antenna 40 M	B50161
T3	Coil – Antenna 20 M	B50168
T2	Coil – Antenna 15 M	B50169
T1	Coil – Antenna 10 M	B50170
T10	Transformer rf 80 M	B50171
T9	Transformer rf 40 M	B50172
T8	Transformer rf 20 M	B50173
T7	Transformer rf 15 M	B50174
T6	Transformer rf 10 M	B50175
	Mounting Clip	A19405
L8	Coil Osc. 80 M	B50197
L7	Coil Osc. 40 M	B50196
L6	Coil Osc. 20 M	B50195
L5	Coil Osc. 15 M	B50194
L4	Coil Osc. 10 M	B50193
L3	Coil Osc. 6 M	B50192
L9	Coil Antenna 6 M	B50190
L10	Coil rf 6 M	B50200



DIAL CORD INSTALLATION AS VIEWED FROM REAR OF SET WITH TUNING CAPACITOR AT MAXIMUM MESH

DIAL CORD ASSEMBLY

STANDARD FORM WARRANTY
of
NATIONAL RADIO COMPANY, INC.
A Wholly owned subsidiary of NATIONAL COMPANY, INC.

This equipment is warranted to be free from defective material and workmanship and repair or replacement will be made of any part which under normal installation, use and service discloses defect, provided the unit is delivered by the owner to the manufacturer or through the authorized radio dealer or wholesaler from whom purchased, intact, for examination, with all transportation charges prepaid to the factory, within ninety days from the date of sale to original purchaser, and provided that such examination discloses in the manufacturer's judgment that it is thus defective.

Damages arising out of the breach of warranty to the owner shall be limited to the return of the goods and repayment of the purchase price or to the repair or replacement of non-conforming goods or parts at the election of the manufacturer.

This warranty does not extend to any radio products which have been subjected to misuse, neglect, accident, incorrect wiring, improper installation, or to use in violation of instructions furnished by the manufacturer, nor does it extend to units which have been repaired or altered outside of the factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith of other manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for the manufacturer any other liability in connection with the sale of their radio products.

National Radio Company, Inc. reserves the right to make any change in design or to make addition to, or improvements in, its products without imposing any obligations upon itself to install them in its products previously manufactured.

NATIONAL RADIO COMPANY, INC.
Melrose 76, Mass.

DESCRIPTION AND OPERATION

The following paragraphs briefly describe the recommended operating procedure for the National NC-155 Receiver, and also include a brief circuit description. Paragraphs in standard type face concern operating instructions only; those in bold face type describe the circuits.

The National NC-155 receiver is designed to match an unbalanced 70 ohm antenna and transmission line. Individual antenna coils are used on each band. The impedance match is obtained by use of a small primary coupling winding on the antenna coil, with the exception that on the 6 meter band the impedance match is obtained by means of a tap on the antenna coil.

THE ANTENNA

The rear apron of the NC-155 receiver contains a two-terminal antenna strip suitably marked A and G. The simplest antenna is a single long wire illustrated below. When an antenna of this type is used, a suitable ground connection is recommended for best results. Generally speaking, an antenna between 15 feet and 40 feet long should provide ample signal pick-up for most of the amateur bands in use. When the receiver is to be used predominantly on any one band, better results can always be obtained with one of the many types of tuned antennas. The common doublet or half-wave antenna is illustrated below, and may be connected to the receiver antenna terminals by connecting one of the lead wires to the antenna terminal and the other to the ground terminal; although, more satisfactory results will generally be obtained if a suitable balanced-to-unbalanced transformer type coupling is used. Many other types of antenna configurations are available and beneficial under various reception conditions. The subject of antennas, and the matching of antennas to receivers, is in itself a major study. The owner of the NC-155 should consult one of the excellent references published by the American Radio Relay League and other organizations. In all cases where an external exposed antenna is used, suitable consideration should be given to lightning protection for the safety of the operator and the equipment.

The proper antenna coil is selected by means of the BAND switch that switches the primary and secondary windings of the desired coil, thereby connecting the desired winding to the receiver circuit.

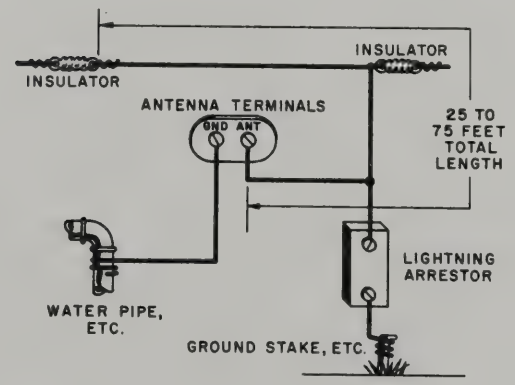
BAND SWITCH

BAND switching is actuated by means of the BAND switch on the front panel. This switch is simply placed in the desired BAND position as indicated by the various amateur band markings: 80, 40, 20, 15, 10, and 6. When the BAND switch has been set for the band desired, the corresponding dial scale carrying the identical band marking is used to indicate the frequency of receiver tuning.

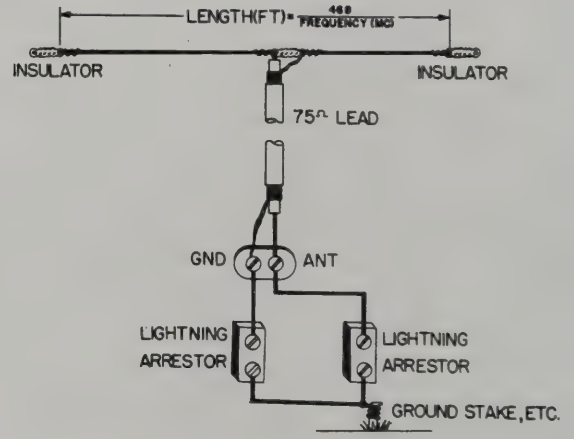
The secondary of the antenna coil is used as a tuned circuit to achieve selectivity in the antenna stage of the receiver. This coil is tuned by means of the main tuning capacitor C1, and the antenna trimmer. It should be noted that the stator plates of the main tuning capacitor are split into two sections with one or both sections being used, depending on the band selected, thus providing for use of the entire dial on each amateur band.

ANTENNA TRIMMER

The ANTENNA trimmer control is used to make a final adjustment of the tuned circuit to insure maximum gain on



SINGLE WIRE ANTENNA



DOUBLET ANTENNA

IMPORTANT

READ CAREFULLY BEFORE TURNING ON YOUR NEW NC-155

The following instructions are designed to allow you to immediately set up your new NC-155 for proper operation using AM, SSB, or CW receiving techniques. They are ONLY intended to provide a quick reference for proper set-up procedure, and we strongly recommend that you study the instruction manual carefully as soon as possible.

AM OPERATION

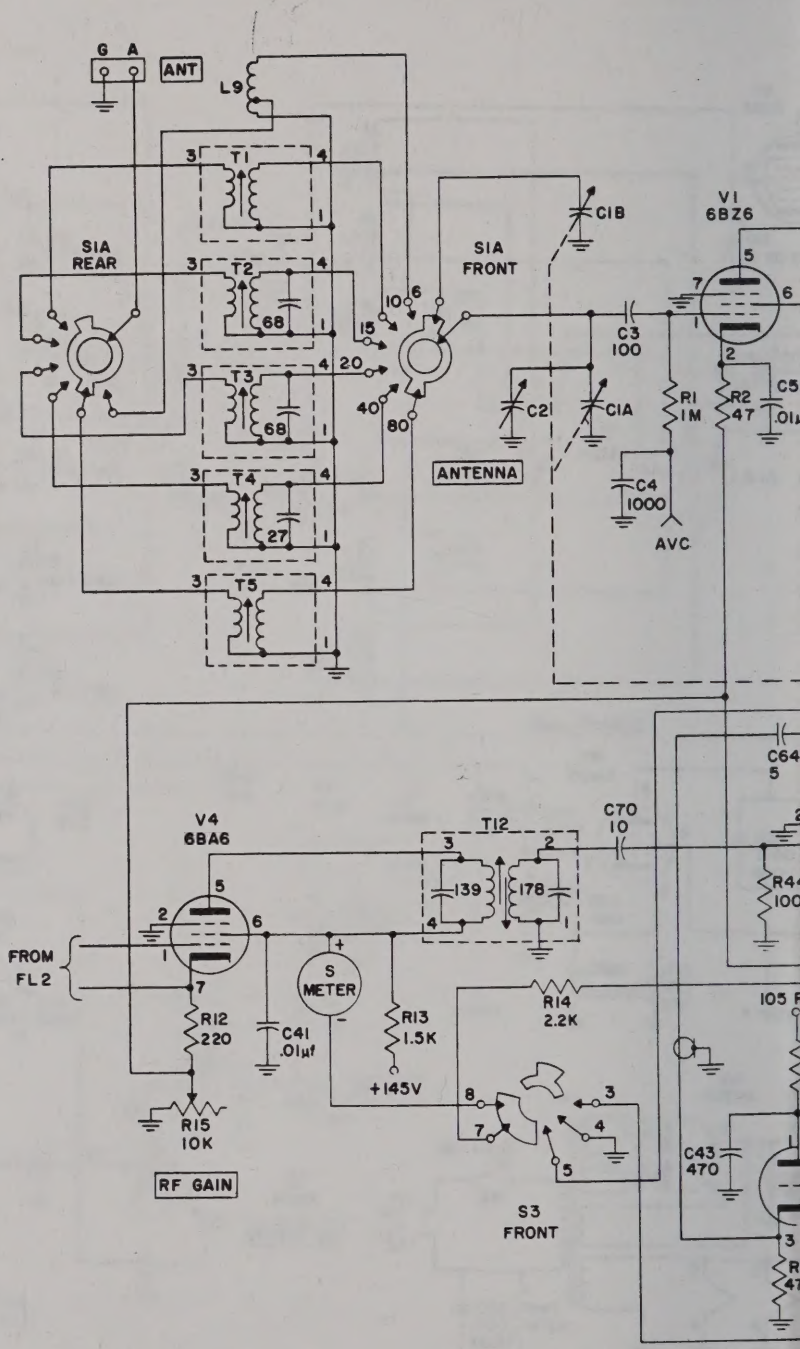
1. Set BAND switch to desired band.
2. Turn STBY-REC toggle switch to REC.
3. Rotate FUNCTION knob (lower left of Main Tuning knob) to AM. Note that there are two AM positions, the left for operation without AGC (Automatic Volume Control), and the right providing AGC. When the right-hand AM position is being used, the S Meter is operative and indicates relative signal strength.
4. Turn SELECTIVITY knob (lower right of Main Tuning knob) to 5 kc or 3 kc.
5. Turn RF GAIN knob fully clockwise.
6. Turn AUDIO GAIN knob clockwise to apply power to the receiver. Volume may be adjusted to a comfortable listening level.
7. Peak ANTENNA knob for maximum background noise in the absence of a signal.
8. Atmospheric noise or man-made electrical interference may be alleviated by rotating FUNCTION knob to ANL (Automatic Noise Limiter). There are two ANL positions, one for ANL action with AGC, the other for ANL action without AGC.

SSB OPERATION

1. Set BAND switch to desired band.
2. Turn STBY-REC toggle switch to REC.
3. Rotate FUNCTION knob (lower left of Main Tuning knob) to SSB-CW. Note that there are two SSB-CW positions, the left allowing operation without AGC (Automatic Volume Control) and the right providing AGC. When the right-hand SSB-CW position is used, the S-meter is operative and indicates relative signal strength.
4. Turn BFO knob to LSB or USB to select proper sideband (usually LSB on 80- and 40-meters, USB on the 20-, 15-, and 10-meter bands).
5. Turn the SELECTIVITY knob (lower right of Main Tuning knob) to 3 kc.
6. Rotate RF GAIN knob fully clockwise.
7. Turn AUDIO GAIN knob clockwise to apply power to the receiver. As soon as the receiver warms up, volume may be adjusted to a comfortable listening level.
8. Peak ANTENNA knob for maximum background noise in the absence of a signal.

CW OPERATION

1. Set BAND switch to desired band.
2. Turn STBY-REC toggle switch to REC.
3. Rotate FUNCTION knob (lower left of Main Tuning knob) to SSB-CW, AGC off.
4. Turn SELECTIVITY knob to .6 kc (600 cycles).
5. Turn BFO knob to approximately 1:30 o'clock.
6. Rotate RF GAIN knob to an initial setting of 3 o'clock. Receiver volume is adjusted with this control following step 8.
7. Turn AUDIO GAIN control clockwise to apply power to the receiver; set it at 12 o'clock. As soon as the receiver warms up, volume may be adjusted with RFG knob to a comfortable listening level. The AUDIO GAIN knob should remain at approximately 12 o'clock since the excellent product detector in the NC-155 provides ample listening volume.
8. Peak Antenna knob for maximum background noise in the absence of a signal.
9. Adjust BFO knob, if necessary, for most pleasing CW pitch.
10. CW operation with automatic gain control may be obtained by following the instructions for SSB OPERATION.


G A
ANT
L9
T1
T2
T3
T4
T5
SIA REAR
SIA FRONT
C1B
V1 6BZ6
C3 100
C2
C1A
R1 1M
R2 47
C4 1000
AVC
ANTENNA
V4 6BA6
T12
C70 10
139
178
FROM FL2
S METER
R12 220
C41 .01µf
R13 1.5K
R14 2.2K
+145V
R15 10K
RF GAIN
S3 FRONT
C43 470

SPECIFICATIONS

Frequency Ranges

6 meter band (50.0 - 54.0 mc)
10 meter band (28.0 - 29.7 mc)
15 meter band (21.0 - 21.5 mc)
20 meter band (14.0 - 14.4 mc)
40 meter band (7.0 - 7.3 mc)
80 meter band (3.5 - 4.0 mc)

Tuning Control

60:1 step down ratio with pinch type drive and 5:1 panel vernier for smooth inertia tuning.

Calibration

Accessory 1 mc crystal calibrator and exclusive National lateral dial adjustment provide for extreme calibration accuracy.

Intermediate Frequencies

1st IF — 2,215 kc,
2nd IF — 230 kc

Image Rejection

Double conversion superheterodyne circuit provides optimum image and intermediate frequency rejection on all bands.

Sensitivity

Better than 1.0 microvolt for 1 watt output,
10 db signal to noise ratio.

Selectivity

Special National "Ferrite Filter"
provides the following bandwidths:
VERY SHARP — 600 cycles
MEDIUM — 3.0 kc
BROAD — 5.0 kc

Reception of Single Sideband Signals

Special National "Ferrite Filter" and Calibrated BFO control provide selection of upper and lower sideband with special triode heterodyne detector and separate carrier reinsertion.

Reception of CW Signals

Heterodyne detector circuit with
separate beat frequency oscillator.

Automatic Gain Control

Operates in AM, CW and SSB positions
or may be disabled for manual control.

Noise Limiter

Automatic type, self-adjusting to
various signal levels.

Signal Strength Meter

Calibrated in S units from "S-1" to "S-9" (at 50 microvolt input) and "10 DB" to "60 DB" above S-9. Operates on AM, CW or SSB reception.

Audio Power Output

3.0 watts, better than 1.5 watts at
10% distortion.

Antenna Input

50 ohm, unbalanced on all bands.

Output Circuit

3.2 ohm for loudspeaker. Separate
front panel headphone jack.

Control Circuits

Standby-Receive switch with separate set of contacts for external control available at rear of receiver. Rear panel circuit is closed in the Standby position only, or terminals on accessory socket provide for external shunting of STBY-REC switch.

Power Line Requirements

105-125 volts A.C. 50-60 cycles 75 watts

Front Panel Controls

Tuning			Selectivity switch
Radio frequency gain			5.0 kc
Beat frequency oscillator			3.0 kc
Antenna trimmer			0.6 kc
Bandswitch			
Mode switch	ANL	AGC on	Phone jack
	AM		Standby-Receive
	CW-SSB		switch
	CW-SSB	AGC off	Audio gain control
	AM		Combination Calibra-
	ANL		tion set and switch

Flip Foot

Unique "Flip Foot" on receiver and matching speaker for maximum operating convenience.

Dimensions

8⅝" high 15⅝" wide 9" deep
Shipping Weight 28 lbs.